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PRELIMINARY TRAINING PLAN

FOR

THE LUNAR EXCURSION MODULE PROGRAM

VOLUME II - GROUND CREW TRAINING [U]

CODE 26512

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ABSTRACT

This document describes the training program recommended for NASA engineers and technicians engaged in the support of preflight operations, launch operations, and flight operations of the Lunar Excursion Module.

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INTRODUCTION

This document, Volume II of the Training Plan, is submitted in accordance with the requirements of Exhibit E of Contract NAS 9-1100. It is Volume II of a two-volume Type I document, NASA approval pending. As Volume I describes the program of training recommended for the development of qualified flight crews, Volume II describes the program of training recommended for associated ground crews in the Lunar Excursion Module Program.

The program recommended is predicated upon an early analysis of the anticipated tasks and functions of existing ground crews now operating within the Manned Spacecraft Center (MSC) and presently engaged in the support of Gemini and Apollo programs.

Training is expected to occur at MSC, WSMR and AMR and has been scheduled to meet the requirements of each facility. A short, two-day briefing is recommended in early 1964, followed at the earliest practical time by a detailed systems engineering course.

1.0 TRAINING PROGRAM REQUIREMENTS

1.1 Program Scope

1.1.1 This volume is primarily concerned with the training of LEM ground crew personnel associated with preflight, launch and flight operations of the Lunar Excursion Module.

1.2 Analysis and Planning

1.2.1 The need to train ground crew personnel requires a comprehensive analysis of all ground crew personnel tasks, functions, and responsibilities.

Establishment of this recommended training program involved:

1) A preliminary study and analysis of existing ground crew operations at AMR and the MSC at Houston.

2) Analysis and study of the anticipated and predicted tasks associated with the Launch Control Center (LCC) and the Integrated Mission Control Center (IMCC).

3) Preliminary determination of the tasks associated with the operation of Ground Operation Support System (GOSS) remote sites.

4) Analysis of the anticipated requirements as described by the Flight Crew Operations Division, Houston.

5) Analysis of the preliminary requirements established by the Flight Controller Operations Branch.

6) Analysis and study of prior systems training operations associated with the Gemini and Apollo programs, as described by staff members of the Flight Operations Division, Houston.

1.3 LEM Ground Crew Description and Training Requirements

1.3.1 The LEM Ground crew consists of NASA engineers and technicians, responsible for prelaunch, launch and flight operations. In addition to Spacecraft (S/C) operations, NASA engineers are responsible for IMCC, LCC, GOSS and flight crew training programs with associated simulation equipments. Ground crew training requirements vary among ground crew members according to their tasks and responsibilities, and are so indicated in Table 1.0.

2.0 GROUND CREW TRAINING PROGRAM

2.1 Objectives

The recommended Ground Crew Training program is designed to meet the following major objectives in the successful and timely conducting of the LEM program.

2.1.1 Provide detailed instruction on LEM systems, in scope and depth, according to requirements for various personnel.

2.1.2 Provide detailed instruction on that ground support equipment pertinent to the tasks of various personnel.

2.1.3 Perfect the coordination of ground and flight crew members, as may be required by task relationships.

2.1.4 Schedule all training to ensure the required state-of-readiness in support of the operational timetable.

2.1.5 Revise and update training studies and training plans by continued task analysis.

2.2 Recommended Training Methods

2.2.1 Formal training is recommended for POD, FOD, FCOD, FCOB and LOC personnel. Formal training should be conducted in classrooms available at MSC, AMR and contractor facilities. Training aids such as films, slides, manuals, engineering drawings, simulation equipment and television systems should be used wherever applicable. On the job training for POD and FCOB personnel is recommended to supplement formal Training. On the job training should be conducted under the supervision of contractor engineering personnel at NASA and contractor facilities.

2.3 Recommended Program Phasing

2.3.1 Field engineering services should be utilized in accordance with schedule requirements, and should include consultant service, contractor liaison, and updated information on an informal and continuing basis.

2.3.2 The LEM Mission, Vehicle, and Systems Briefing should be presented as early in the program as is practicable. It should be of scope and depth to suffice for orientation and technical familiarization. It should be equally important as background to detailed formal courses in systems engineering, and, therefore, presented repeatedly at the various training, test and launch sites as the crews are phased or augmented. Developments and modifications in the LEM will cause necessary revisions of the briefing. Training aids and materials should be in portable kits for use by the Presentation Team. Table 2.0 is an example of a recommended course syllabus. It should be revised as new information becomes available.

2.3 Recommended Program Phasing (Continued)

2.3.3 The LEM Systems Engineering Courses should provide detailed functional and engineering information on each system and its relationships and interfaces with other systems. Each course should be designed to follow and enlarge upon the briefing presentation as applied to the particular system to be considered.

The courses should be scheduled carefully with respect to the over-all LEM Program so that the information is current with development and modifications, and as fresh as possible in the minds of trainees when they are to apply it to test or operational tasks. Careful scheduling will permit greater participation of NASA engineering personnel in the design and development of the spacecraft than would be otherwise possible with more informal engineering drawings and documentation review and consultation with contractor engineering personnel.

2.3.4 LEM Training Simulator operation and programming, including scope, type, and procedures for exercises, should be presented to all Simulation Engineers, Simulation Systems Engineers, Chief Simulator Operators and Simulator Communications Operators. This training should follow closely the LEM Mission, Vehicle, and Systems Briefing, and the systems engineering courses, for those who have received the latter courses.

2.3.4.1 LEM Training Simulator hardware has been recommended in Volume I of this Training Plan. The hardware recommendations and schedules have not been approved by NASA. Recommendation for personnel training will be included in revised issues of this Volume II Training Plan.

3.0 Recommended Training Aids

Preliminary task analysis of FOD, POD, FCOD, FCOB and LOC Ground Crew Personnel has indicated an enormous variety of complex tasks associated with the inspection, operation and maintenance of the LEM spacecraft. As indicated in Table 1.0, LEM spacecraft systems training is required by all Ground Crew Personnel. Specific S/C system training, however, must satisfy the training requirements dictated by the critical tasks performed by each operating division. Many of the individual tasks studied have indicated a variety of training requirements within the scope of one position. An example would be the POD engineer who supervises the acceptance test program for a particular system. He is concerned with system operation and performance. In the event of system failure, he also will be concerned with maintenance and maintenance procedures. Prior to the acceptance test phase, he is concerned with the design, manufacturing processes and Quality Control procedures associated with his system.

In view of the diversified tasks and diversified training requirements, actual spacecraft equipment (prototype, developmental or deliverable) should be utilized, if available as training aids. In addition to the spacecraft equipment a full scale LEM mock-up is recommended.

The full scale mock-up should be designed to perform the following training functions:

1) Familiarization with LEM system layout and system accessibility.

2) Familiarization with LEM spacecraft controls and displays.

3) Familiarization with the location of LEM spacecraft harnesses, plumbing and tanks.

4) Familiarization with procedures for removal and replacement of systems.

5) Familiarization with ingress and egress with spacecraft systems and Ground Support Equipment.

Where training of ground crew personnel involves timed and coordinated activity, the Part Task Trainer and Full Mission Simulator should be utilized. The Part Task Trainer and Full Mission Simulator are described in Volume I of the LEM Training Plan.

4.0 Ground Crew Training Schedules

A recommended Ground Crew Training Schedule is presented in

4.0 Ground Crew Training Schedules (Continued)

Figure 1. Figure 1 provides recommended course preparation periods and training programs needed to prepare the initial NASA Ground Crews engaged in early LEM test operations at WSMR (P5) and AMR (LEM 3).

Training Programs as scheduled were based upon:

1) Early LEM Briefings for FCOD and ASPO, MSC Houston.

2) Propulsion Test Activity at WSMR; PA-5 Ascent Rig and PD-5 Descent Rig.

3) LEM 3 Pre-Launch Activity at AMR.

4) LTA5 and LTA9 Activity at WSMR.

TABLE 1.0 PERSONNEL TRAINING REQUIREMENTS

Personnel	Training Requirements
Flight Controller Operations Branch	
1) Flight Controllers	1) LEM systems training. LEM system operation, performance and malfunction detection. LEM system malfunctions and operational solutions. Network operations training. Flight plans and mission techniques.
2) Systems Monitors	2) LEM systems training. LEM systems operation and systems performance. Discrete system operating parameters including telemetered data and display techniques. Malfunctions detection and operational solutions.
3) Control Center and GOSS Personnel	3) LEM systems training. Network operating procedures. Flight plans and mission plan rules and techniques.
Flight Crew Operations Division	
1) Simulation Engineers	1) LEM systems training. Flight plans and mission plans. Network operating procedures. S/C operating procedures. Mission rules and flight techniques, S/C malfunctions and remedial solutions. Simulator operations and programming capabilities. Simulation exercises; scope, type and procedures.
2) Simulation Systems Engineers	2) LEM systems training, including design criteria, operation--normal and abnormal performance--throughout environmental spectrum, and simulation techniques. Detailed part-task and full mission simulator design and operations training. Simulator training to include operation, programming, simulated S/C malfunctions, displays and controls.
3) Simulator Operations Personnel Chief Simulator Operator	3) LEM systems training. LEM systems malfunctions and simulation techniques. Simulator display, control, data process and acquisition techniques.

TABLE 1.0 PERSONNEL TRAINING REQUIREMENTS (continued)

Personnel	Training Requirements
Flight Crew Operations Division	
Simulator Operator - Telemetry	Mission simulator telemetry displays and interface to IMCC via Simulation Checkout and Training System (SCATS).
Simulator Operator - Communications	Training for voice communications procedures, as related to the LEM simulator, IMCC and GOSS networks.
Simulator Operator - Systems	Simulator turn-on procedure, computer checkout, display checkout, simulator maintenance and console maintenance.
4) Simulation Equipment Maintenance Personnel	4) Simulation equipment operation and maintenance procedures.
Flight Operations Division	
1) FOD Engineers	1) LEM systems training. LEM systems training emphasizing operation, system performance, S/C performance prelaunch checkout and test procedures and flight checkout and test procedures.
Preflight Operations Division	
1) Test Conductors	1) LEM systems training. Systems training to emphasize prelaunch test and checkout procedures, malfunction detection techniques and remedial procedures.
2) S/C Systems Engineers	2) Selected LEM systems training. Systems training with emphasis on each system engineer's speciality; e.g. S/C instrumentation--systems training emphasizing S/C instrumentation, including location, types, ranges, accuracies, calibration techniques, conversion methods and readout systems.
3) Ground Support Equipment (GSE) Engineers	3) Selected LEM GSE training, emphasizing not only specific GSE but related S/C systems. Training should include detail on interface of S/C systems and related GSE.

TABLE 1.0 PERSONNEL TRAINING REQUIREMENTS (continued)

Personnel	Training Requirements
Preflight Operations Division (cont'd)	
4) Quality Control (Q.C.) Personnel	4) Selected LEM systems training with emphasis on reliability and Q.C. techniques and procedures.
Launch Operations Center	
1) Facility Engineers & Technicians	1) Selected LEM systems training with emphasis on booster and launch vehicle interface.

TABLE 2.0

LEM SYSTEMS BRIEFING - TWO-DAY COURSE SYLLABUS

I INTRODUCTION

A. Briefing Objectives

B. Briefing Scope

C. Schedule

II LEM SPACECRAFT DESCRIPTION & MISSION OBJECTIVES

A. Mission Plans & Flight Plans

III LEM SPACECRAFT HARDWARE FAMILIARIZATION

A. Spacecraft Structure

1. Crew Capsule
2. Equipment Compartment
3. Propulsion Stages
4. Tanks
5. Separation & Docking Mechanism
6. Landing Gear

B. Crew Provisions

1. Life Support Systems
2. Crew Displays
3. Crew Controls

C. Descent Propulsion System

1. Descent Engine System
2. Descent Engine Propellants
3. Propellant Feed Systems
4. Engine Control
5. Engine Gimballing
6. Engine Instrumentation

D. Ascent Propulsion System

1. Ascent Engine System
2. Propellant Feed System
3. Ascent Engine Control
4. Ascent Engine Instrumentation

E. Electrical Power System

1. Fuel Cell
2. Cryogenic Storage & Supply
3. AC & DC Power Distribution & Control

TABLE 2.0

LEM SYSTEMS BRIEFING - TWO DAY COURSE SYLLABUS

III LEM SPACECRAFT HARDWARE FAMILIARIZATION - continued

F. Environmental Control System

1. Atmosphere Revitalization Section
2. O_2 Supply & Cabin Pressure Control
3. Heat Transport Section
4. Water Management Section

G. Reaction Control System

1. RCS Engines
2. Engine Mounts
3. Propellant Storage - Feed & Control

H. Stabilization & Control System

1. Programmer Section
2. Rate Gyro Package
3. Guidance Coupler Section
4. Modes
5. Control Circuits
6. Functional Interfaces with N & E, Propulsion, RCS, Pilot's Displays

I. Navigation & Guidance System

1. Optics Section
2. Inertial Measurements Unit
3. Radar Section
4. Computer Section

J. Communication System

1. LEM/Command Module Section
2. LEM/Earth Section
3. LEM/Roving Astronaut Section

K. Instrumentation System

1. Checkout and Monitoring of Systems
2. Monitoring of Biological Sensors
3. PCM/TE
4. Ground Station Monitors and Flight Controllers

L. Ground Support Equipment

1. Test and Checkout Equipment
2. PACE Adapter Equipment
3. Ground Handling Equipment
4. Servicing Equipment

TABLE 2.0

LEM SYSTEMS BRIEFING - TWO-DAY COURSE SYLLABUS

III LEM SPACECRAFT HARDWARE FAMILIARIZATION - continued

M. LEM Test and Development Program

LEM GROUND CREW TRAINING SCHEDULE

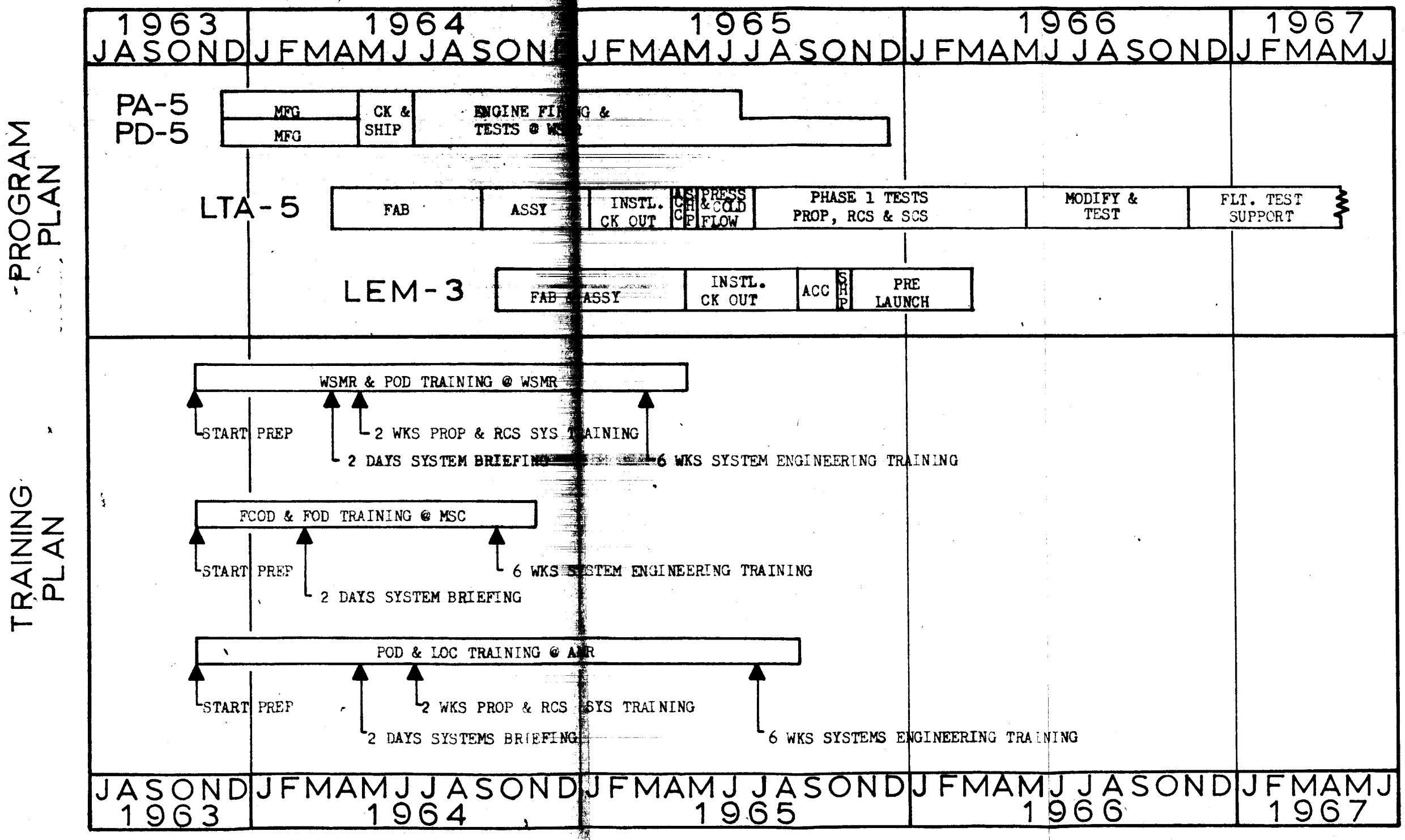

FIGURE 1

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